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Comment on egusphere-2022-232

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Referee comment on "Impulse-driven oscillations of the near-Earth's magnetosphere" by Hiroatsu Sato et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-232-RC2, 2022

Title: Impulse-driven oscillations of the near-Earth's magnetosphere

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[Comments]

There are major questions as listed below.

- The ground magnetic variations at high latitudes are described as being caused by magnetopause currents. However, ground magnetic variations at high latitudes are caused by ionospheric Hall currents driven by the electric field created by the dynamo in the outer magnetosphere (e.g., Tanaka et al., 2020 JGR, https://doi.org/10.1029/2019JA027172). Furthermore, the field-aligned currents generated by the dynamo flow to the global ionosphere via the polar ionosphere, resulting in simultaneous occurrence of the preliminary impulse (PI) and main impulse (MI) of SC at high latitude and equator (Araki, 1994 AGU book). The authors are recommended to discuss their results in the context of the current system between the magnetosphere and ionosphere. The dynamos of the PI and MI have also been reproduced by the global simulations (Slinker et al., 1999 JGR; Fujita et al, 2003 JGR).
- Damping of the magnetosphere is attributed to the non-linearity of the equation (4).

On the other hand, the FACs flow into the polar ionosphere and further to the global ionosphere, where the energy is consumed by the Pedersen currents (e.g., Kikuchi et al., 2021 EPS). When discussing the damping of the ground magnetic fields, it is advisable to discuss the energy loss in the ionosphere.

- The motion of plasma is described as being earthward, but the calculated and observed electric fields presented in the present paper are directed from the dawn to dusk, which drives sunward motion of plasma. Explanation or comments are required for the difference between the compression of the magnetopause and sunward motion of the magnetospheric plasma.

[Others]

Line 116

The Faraday's law is equivalent to E=UxB?

Line 124

In Figure 9, the electric field is from the dawn to dusk, which drives sunward motion of plasma in the magnetosphere. If the electric field is induced by the increase in Bz and carried by the compressional MHD wave toward the Earth, the direction of the electric field must be westward, i.e., from the dusk to dawn. How is the dawn-to-dusk electric field generated by the moving magnetopause currents?

Line 147

Draw current vectors on the current lines of the FACs. Previous studies using the global simulations have shown that two kinds of FACs are generated by the compression of the magnetosphere (Slinker et al., 1999 JGR; Fujita et al., 2003 JGR; Tanaka, 2007 SSR), supplying the electric field and currents of the PI and MI of SC. The FAC pair inside the

outside pair is also produced by the magnetopause currents?

Line 149

Please specify the energies of radiation belt particles and of particles that work as a generator of the FAC.

Line 157

Please note that the infinite inner impedance does not allow electric currents to flow, since I=V/(r+R) where r and R are the internal and load resistivities.

Line 160

Please note that the FAC is generated by the high-pressure plasma so that the pressure gradient force balances JxB force of the dynamo current J (Tanaka, 2007 SSR).

Lines 160-163

The equations for the current are the same in the warm and cold plasma regions. Please comment on the difference between the nature of the two currents.

Line 209

Ground magnetic disturbances are caused by ionospheric currents, particularly at auroral and subauroral latitudes (e.g., Araki et al., 1997 JGR). At middle and low latitudes, the magnetic fields are caused by magnetopause currents superimposed by weak ionospheric currents. At the dayside equator, the ionospheric Cowling currents work as a major source for the equatorial SC (Araki, 1994 AGU book).

Line 235

Figure 17 shows a typical SC in the morning, composed of positive/negative PI and negative/positive MI at lower/higher latitude part of the IMAGE magnetometer array. These magnetic fields are caused by ionospheric Hall currents surrounding the FACs (e.g., Kikuchi et al., 2022 Frontiers, doi: 10.3389/fspas.2022.879314). Note that the onset of PI at higher latitude (NAL, BJN) is simultaneous with those at lower latitude (NUR,,,,), because the ionospheric currents flow at the speed of light to the global ionosphere, including the equator (Kikuchi et al., 2021 EPS, DOI: 10.1186/s40623-020-01350-8). Magnetopause currents cause magnetic fields at low latitude, which is DL according to Araki (1994) model.

Line 248

Which part of the data is believed to have been caused by FAC?

Line 253

The electric fields measured by the satellites are from the dawn to dusk (Fig. 21), same as in the model calculation (Fig.9). The ExB drift velocity is sunward, which is opposite to the earthward motion of the magnetopause. The electric field observed in the ionosphere at middle latitude is also directed from the dawn to dusk, which lifts up the dayside ionosphere (Kikuchi et al., 2016 JGR, doi:10.1002/2015JA022166).

Line 259

RBSP spacecrafts are located deep inside the magnetosphere, not close to the magnetopause. The location of spacecrafts should be explicitly mentioned in the discussion.

Line 300

Phase relationships among the ground magnetic variations should be mentioned. If the magnetic variations are caused solely by the magnetopause currents, we would see coherent variations in multiple locations.

Please also note the supplement to this comment:
https://egusphere.copernicus.org/preprints/2022/egusphere-2022-232/egusphere-2022-232-RC2-supplement.pdf